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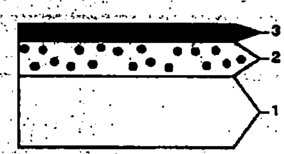
(54) [Title of Invention]

MULTILAYER FILM AND PRODUCTION METHOD THEREOF

(57) [ABSTRACT]
[Problem to be Solved] By improving surface scratch resistance by increasing surface hardness of low refractive index layer, this invention provides a multilayer film to be preferably used as an antireflection film which has a low reflection and is excellent in flexural property, and a production method thereof.
[Means for Solving the Problem] A multilayer film characterized in that one or more layers of an electrically conductive layer containing inorganic particles are provided on at least one surface of a substrate film, and on said electrically conductive layer, one or more layers of a resin layer of which refractive index is 1.5 or more comprising a cured product in which a fluorine-containing compound shown by the following formula A and a multi-functional (meth)acrylate shown by the following formula B are reacted, are provided.

Formula A: $(CH_2{=}CX\text{-}COO)a - Y$

Formula B: (Q1-O)b-Z-(O-Q2)c



[SCOPE OF CLAIMS]

[Claim 1] A multilayer film characterized in that, one or more layers of an electrically conductive layer containing inorganic particles are provided on at least one surface of a substrate film, and on said electrically conductive layer, one or more layers of a resin layer of which refractive index is 1.5 or more comprising a cured product in which a fluorine-containing compound shown by the following formula A and a multi-functional (meth)acrylate shown by the following formula B are reacted are provided.

Formula A: $(CH_2 = CX - COO)a - Y$

(in the formula, X denotes hydrogen atom or an alkyl group with 1 to 3 carbon atoms, Y denotes a fluorine-containing alkyl group with 1 to 100 carbon atoms and may contain one or more ether bonds or ester bonds. "a" is an integer of 1 to 4.)

Formula B: (Q1-O)b-Z-(O-Q2)c

(in the formula, Z denotes an alkyl group with 1 to 100 carbon atoms containing one or more of linear peptide bond, branched peptide bond, cyclic peptide bond, urethane bond, amide bond or imide bond. Furthermore, Q1 and Q2 denote (meth)acryloyl group and, "b" and "c" are integers of 1 to 6.)

[Claim 2] A multilayer film according to Claim 1 characterized in that the fluorine-containing compound contains at least one group of (meth)acryloyl group, epoxy group, hydroxyl group, carboxyl group or isocyanate group.

[Claim 3] A multilayer film according to Claim 1 or 2 characterized in that the electrically conductive layer comprises an inorganic particles and a multi-functional (meth)acryl-based binder.

[Claim 4] A multilayer film according to any one of Claims 1 to 3 characterized in that the inorganic particle is zinc antimonate.

[Claim 5] A multilayer film according to any one of Claims 1 to 4 characterized in that the electrically conductive layer contains a multi-functional (meth)acryl-based binder containing one or more urethane bonds.

[Claim 6] A multilayer film according to any one of Claims 1 to 5 characterized in that the substrate film is a polyester film.

[Claim 7] A multilayer film according to any one of Claims 1 to 6 characterized by further having a hard coat layer between the substrate film and the electrically conductive layer.

[Claim 8] A production method of a multilayer film characterized in that one or more layers of an electrically conductive layer containing inorganic particles are formed on at least one surface of a substrate film, and then on said electrically conductive layer, one or more layers of a resin layer of which refractive index is 1.5 or more comprising a cured product in which a fluorine-containing compound shown by the following formula A and a multi-functional (meth)acrylate shown by the following formula B are reacted are provided.

Formula A: $(CH_2{=}CX\text{-}COO)a - Y$

(in the formula, X denotes hydrogen atom or an alkyl group with 1 to 3 carbon atoms, Y denotes a fluorine-containing alkyl group with 1 to 100 carbon atoms and may contain one or more ether bonds or ester bonds. "a" is an integer of 1 to 4.)

Formula B: (Q1-O)b-Z-(O-Q2)c

(in the formula, Z denotes an alkyl group with 1 to 100 carbon atoms containing one or more of linear peptide bond, branched peptide bond, cyclic peptide bond, urethane bond, amide bond or imide bond. Furthermore, Q1 and Q2 denote (meth)acryloyl group and, "b" and "c" are integers of 1 to 6.)

[Claim 9] A production method of a multilayer film according to Claim 8 characterized in that a coating liquid in which a mixture of the fluorine-containing compound and the multi-functional (meth)acrylate is dispersed by using at least one kind selected from a fluorine-based solvent, dimethyl imidazolidinone, N-methyl pyrrolidone, dimethyl formamide, diglyme, γ-butyl lactone, propylene glycol monomethyl ether and dimethyl sulfoxide as solvent is coated and then dried and cured to form a resin layer.

[Claim 10] A production method of a multilayer film according to Claim 8 or 9 characterized in that a coating liquid in which the mixture of the inorganic particles and the uncured multi-functional (meth)acryl-based binder are dispersed by using at least one kind selected from dimethyl imidazolidinone, N-methyl pyrrolidone, dimethyl

formamide, diglyme, γ-butyl lactone, propylene glycol monomethyl ether and dimethyl sulfoxide as a solvent is coated on at least one surface of the substrate film, and then dried and cured to form an electrically conductive layer.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention] The present invention relates to a multilayer film used preferably as an antireflection film or the like applied to surfaces such as a display surface or its polarizing plate surface, and a production method thereof.

[0002]

[Conventional Art] Conventionally, display devices such as TV or PC monitor have a problem that visibility of displayed image decreases due to surface reflection or reflected image of out lights such as sunlight or fluorescent lamp. In order to solve this problem, methods for allowing a diffuse reflection of out light by providing an unevenness on surface, or preventing reflection by alternatively laminating thin layers of a low refractive index and a high refractive index, have been applied.

[0003] However, in the method of allowing diffuse reflection of out light, since an image on the display becomes unclear, it cannot be said to be sufficient in improvement of image visibility. On the other hand, in the method in which a low refractive index fluorine-containing polymer is provided as surface layer such as proposed by Japanese Unexamined Patent Application Publication Nos. 4-355401, 11-92750 and 11-174971, since surface hardness of the fluorine-containing polymer is low and its scratch resistance is insufficient, there was a problem that scratches were gradually produced when said display surface was cleaned, to thereby decrease the image visibility.

[0004]

[Problems to be Solved by the Invention] Under these circumstances, the object of the present invention is to improve the surface scratch resistance by increasing surface hardness of the low refractive index layer and to provide a multilayer film preferably to be used as an antireflection film which has a low reflection and is excellent in flexural property, and a production method thereof.

[0005]

[Means for Solving the Problem] The present invention adopts the following means to solve such a problem.

[0006] That is, the multilayer film of the present invention is achieved by a multilayer film characterized in that one or more layers of an electrically conductive layer containing inorganic particles are provided on at least one surface of a substrate film, and on said electrically conductive layer one or more layers of a resin layer of which refractive index is 1.5 or more comprising a cured product in which a fluorine-containing compound shown by the following formula A and a multi-functional (meth)acrylate shown by the following formula B are reacted is provided.

Formula A: $(CH_2=CX\text{-}COO)a - Y$

(in the formula, X denotes hydrogen atom or an alkyl group with 1 to 3 carbon atoms, Y denotes a fluorine-containing alkyl group with 1 to 100 carbon atoms and may contain one or more ether bonds or ester bonds. "a" is an integer of 1 to 4.).

Formula B: (Q1-O)b-Z-(O-Q2)c

(in the formula, Z denotes an alkyl group with 1 to 100 carbon atoms containing one or more of linear peptide bond, branched peptide bond, cyclic peptide bond, urethane bond, amide bond or imide bond. Furthermore, Q1 and Q2 denote (meth)acryloyl group and, "b" and "c" are integers of 1 to 3.).

[0007]

[Embodiment for Carrying Out the Invention] The multilayer film of present invention is a multilayer film in which one or more layers of an electrically conductive layer containing inorganic particles are laminated on at least one surface of a substrate film, and on the electrically conductive layer, one or more layers of a resin layer comprising a cured product in which a fluorine-containing compound and a multi-functional (meth)acrylate are reacted are provided.

[0008] The light transmittance at 400 to 800 nm of the substrate film of the present invention is preferably 40% or more, more preferably 60%, and the haze is preferably 5% or less, more preferably 3% or less. In case where said light transmittance is less than the above-mentioned range, or in case where the haze is more than the

above-mentioned range, when it is used as a display member, clearness may become insufficient. Furthermore, in order to exhibit such an effect, the upper limit of the light transmittance up to about 99.5% and the lower limit of the haze up to about 0.1% are practical ranges.

[0009] Materials of said substrate film are not especially limited and can be selected and used from known materials for plastic substrate film. As such materials for plastic substrate film, for example, polyester-based, polyethylene-based, polypropylene-based, diacetate-based, triacetate-based, polystyrene-based, polycarbonate-based, polymethyl pentene-based, polysulfone-based, polyether ethyl ketone-based, polyimide-based, fluorine-based, nylon-based and polymethacryl-based resins or the like are mentioned. Among these resins, polyester-based resin, triacetate-based resin and polymethacrylate-based resin are preferably used in view of optical and mechanical properties, and since they are excellent in uniformity.

[0010] In particular, polyethylene terephthalate, triacetyl cellulose and polymethylmethacrylate resins are preferable since they are excellent in transparency and free from an optical anisotropy, and furthermore, in view of optical characteristics and mechanical characteristics, it is especially preferable to use polyester film.

[0011] As the polyesters for said polyester film, polyethylene terephthalate, polyethylene-2,6-naphthalate, polybutylene terephthalate, polyethylene α,β-bis(2-chlorophenoxy)ethane-4,4'-dicarboxylate or the like are mentioned. Furthermore, to these polyesters, other dicarboxylic acid component or diol component may be copolymerized in 20 mol% or less.

[0012] These constituent components may be used alone or in combination of two or more kinds, but among them, when product quality and production cost, etc., are considered in total, polyethylene terephthalate is especially preferable.

[0013] Furthermore, the substrate film used in the present invention may be subjected to various surface treatments (for example, corona discharge treatment, glow discharge treatment, flame treatment, etching treatment, surface roughening treatment or the like) before providing the electrically conductive layer on its at least

one surface. Furthermore, in order to accelerate adhesion, it may also be subjected to a surface coating (for example, polyurethane-based, polyester-based, polyester acrylate -based, polyurethane acrylate-based, polyepoxyacrylate-based, titanate-based compounds or the like). In particular, a substrate film on which a composition comprising a cross-linking agent is primer coated with a copolymer in which an acryl-based compound is grafted to a hydrophilic group-containing polyester resin is preferably used as a substrate film since it improves adhesion and is excellent in durability of heat resistance, water resistance, etc.

[0014] And, the thickness of the substrate film of the present invention is not especially limited, but in view of mechanical strength and heat conductivity, it is usually 5 to 800 μm and preferably 10 to 250 μm. Furthermore, it may be those in which two or more films are laminated by a known method.

[0015] The electrically conductive layer in the present invention is basically constituted with the inorganic particles and an organic resin. As the inorganic particles used in the present invention, inorganic particles containing one or more metals selected from Na, K, Mg, Ca, Ba, Al, Zn, Fe, Cu, Ti, Sn, In, W, Y, Sb, Mn, Ga, V, Nb, Ta, Ag, Si, B, Bi, Mo, Ce, Cd, Be, Pb, Au, Ni or their metal oxides are mentioned, and inorganic particles of an average primary particle diameter (corresponding spherical diameter: BET method) of 0.001 to 0.2 μm are preferably used but more preferably, inorganic particles of particle diameter 0.005 to 0.1 μm are used. If said average primary diameter exceeds the above-mentioned range, the transparency of the produced film (electrically conductive layer) may decrease and it may become difficult to make the film thicker. On the other hand, said average primary diameter is less than the above-mentioned range, said inorganic particles are apt to aggregate and the haze of the produced film (electrically conductive layer) may increase.

[0016] In the present invention, in view of refractive index and electrical conductivity of the produced film (electrically conductive layer), as inorganic particles, antimony-doped tin oxide (ATO), antimony-doped zinc oxide, Indium-containing tin

wet-process silica, titan oxide or the like, silica gel dispersed in a colloidal state, etc.

[0022] The resin layer to be formed on the electrically conductive layer comprises a cured product in which a fluorine-containing compound and multi-functional (meth)acrylate are reacted.

[0023] The fluorine-containing compound used in the present invention is the compound shown by Formula A mentioned below, and fluorine-containing monofunctional (meth)acrylates having (meth)acryloyl group such as 2,2,2-trifluoroethyl (meth)acrylate, fluorine-containing multi-functional (meth)acrylates and fluorine-containing alkyl vinyl ethers, or the like, are mentioned. And in said fluorine compound, a fluorine-containing alcohol, epoxy group, hydroxyl group, carboxyl group, isocyanate group or the like may be contained. When a fluorine-containing compound of which main component is the fluorine-containing monofunctional (meth)acrylate having (meth)acryloyl group is used, it is preferable since coatability is improved, and when a fluorine-containing compound of which main component is the fluorine-containing multi-functional (meth)acrylate having (meth)acryloyl group is used, it is preferable since the surface hardness of resin layer after curing is increased. For that reason, the fluorine-containing compound used in the present invention may contain two or more kinds of fluorine-containing (meth)acrylate having different functionality.

Formula A: $(CH_2{=}CX\text{-}COO)a - Y$

(in the formula, X denotes hydrogen atom or an alkyl group with 1 to 3 carbon atoms, Y denotes a fluorine-containing alkyl group with 1 to 100 carbon atoms and may contain one or more ether bonds or ester bonds. "a" is an integer of 1 to 4.)

In the resin layer of the present invention, it is preferable that the fluorine-containing compound shown by the above-mentioned Formula A is contained in said resin layer, preferably 40wt% or more, more preferably 50wt%, in order to improve the film strength after curing. Said resin layer is obtained by curing the above-mentioned uncured fluorine-containing compound simultaneously with coating on the electrically conductive layer, or after the coating and heat drying, by heat, ultraviolet light, electron beam, etc.

oxide (ITO), zinc oxide/aluminium oxide, antimony oxide, etc., are especially preferable, and more preferably, antimony-doped zinc oxide is used.

[0017] In order to impart antistatic property to the electrically conductive layer of the present invention, it is necessary that the surface resistivity of said electrically conductive layer is low. It is preferable that the surface resistivity of said electrically conductive layer is 10^{11} Ω/square or less, more preferably 10^{8} Ω/square or less.

[0018] The electrically conductive layer of the present invention is a layer of which total light transmittance is preferably 40% or more, more preferably 50% or more, in view of clearness and transparency.

[0019] As the organic resin constituting the electrically conductive layer, an aliphatic polyvalent alcohol multi-functional (meth)acrylate such as dipentaerythritol hexa(meth)acrylate, a reaction product between glycidyl (meth)acrylate and a polyvalent alcohol or a polyvalent carboxylic acid, and alkyl ethers, alkenyl ethers, carboxylic acid esters, phosphoric acid esters or urethanized products of (meth)acrylate compounds having unreacted hydroxyl group, or the like are mentioned. Among them, especially, in view of surface hardness after curing, aliphatic polyvalent alcohol multi-functional (meth)acrylate is preferable. Furthermore, when a highly polar bond such as said urethane bond or the like is contained in the multi-functional (meth)acrylate, dispersibility of the inorganic particles is improved and it is especially preferable.

[0020] Furthermore, the range of compounding ratio of inorganic particles used in the present invention is, based on 1 part by weight of the total amount of the organic resin component such as the multi-functional (meth)acrylate, preferably 0.01 to 20 times parts by weight, more preferably 0.05 to 18 times parts by weight, still more preferably, 0.5 to 10 times parts by weight.

[0021] In the present invention, to the constituent component of the electrically conductive layer, in order to impart electrical conductivity, it is possible to include an electrically conductive polymer such as polypyrrole and polyaniline, an organic metal compound such as metal alcoholate and chelate compound, alkyl silicates and their hydrolyzed products, inorganic particles such as colloidal silica, dry-process silica,

[0024] Furthermore, in order to keep the viscosity of coating liquid comprising the uncured fluorine-containing compound low and to improve coatability, the molecular weight of the uncured fluorine-containing compound is, preferably 3000 or less, more preferably 1500 or less. Furthermore, if the number of carbon in the fluorine-containing alkyl group of the uncured fluorine-containing compound exceeds 100, the surface tension of the uncured coating liquid of which main component is said fluorine-containing compound extremely decreases to impair the coatability to the electrically conductive layer, and accordingly, the number of carbon of the alkyl group is preferably 100 or less.

[0025] The multi-functional (meth)acrylate used in the present invention is the compound shown by Formula B mentioned below, and aliphatic polyvalent alcohol multi-functional (meth)acrylate such as dipentaerythritol hexa(meth)acrylate, or a reaction product of glycidyl (meth)acrylate with polyvalent alcohol or polyvalent carboxylic acid, alkyl ethers, alkenyl ethers, carboxylic acid esters, phosphoric ester, urethanized compound of (meth)acrylate compounds having unreacted hydroxyl group or the like are mentioned. Among these, especially, in view of surface hardness after curing, aliphatic polyvalent alcohol multi-functional (meth)acrylate is preferable. Furthermore, if the multi-functional (meth)acrylate has a highly polar bond such as said urethane bond, it is preferable since it improves coatability.

[0026] The amount of said multi-functional (meth)acrylate to be used is the same amount or less as that of the fluorine-containing compound in wt% ratio, and it is preferable to be 0.01 to 50 wt% to the total of said resin layer, and more preferably 0.05 to 10 wt%, in view of improving the hardness of the resin film after curing.

Formula B: (Q1-O)b-Z-(O-Q2)c

(in the formula, Z denotes an alkyl group with 1 to 100 carbon atoms containing one or more of linear peptide bond, branched peptide bond, cyclic peptide bond, urethane bond, amide bond or imide bond. And, Q1 and Q2 denote (meth)acryloyl group and, "b" and "c" are integers of 1 to 6.).

In order to impart a low reflection property to the multilayer film of the present invention, it is preferable that the relation between the refractive index of resin layer

and its thickness is such that their product becomes 1/4 of the wavelength of the light to be reflected (usually, visible light). Accordingly, in the resin layer, it is preferable that 4 times of the product of thickness "d" of said resin layer and the refractive index of said resin layer is present in the range of 380 to 780nm. That is, it is preferable that the relation between the refractive index "n" and the thickness of said resin layer is a thickness in the range which satisfies the Formula (1) mentioned below.

$n \cdot d = \lambda/4$ ··· Formula (1)

(Where, λ is wavelength range of visible light, and it is usually in the range of $380\ nm \leqq \lambda \leqq 780\ nm$.)

Furthermore, in order to impart a low reflection property to the multilayer film of the present invention, it is necessary that the refractive index of the resin layer is smaller than the refractive index of the electrically conductive layer. Accordingly, the refractive index of said resin layer is substantially 1.5 or less, and 1.47 or less is preferable, and more preferably, it is 1.35 to 1.45. Regarding the measurement method of the refractive index, it is measured according to Japanese Industrial Standard JIS K 7105 by using an Abbe refractometer.

[0027] Furthermore, if the refractive index of said resin layer is too low, the coatability of coating liquid of said resin layer cannot be sufficiently obtained, and if it is more than the above-mentioned range, a low reflection property may become insufficient.

[0028] The thickness of resin layer of the present invention is preferably in the range of 0.01 to 1 μm, and more preferably 0.09 to 0.2 μm.

[0029] Furthermore, it is preferable that the thickness of said electrically conductive layer is 0.01 to 50 μm, and 0.05 to 30 μm is more desirable. If the thickness of the electrically conductive layer is thinner than the above-mentioned range, the scratch resistance may become insufficient, and if the thickness of the electrically conductive layer is thicker than the above-mentioned range, a crack may be produced.

[0030] Next, the production method of the multilayer film of the present invention is explained.

[0031] The multilayer film of the present invention can be produced by forming one or more layers of the electrically conductive layer containing inorganic particles on at

least one surface of the substrate film, and subsequently, on said electrically conductive layer, by forming one or more layers of the resin layer of which refractive index is 1.5 or more comprising a cured product in which a fluorine-containing compound shown by the following formula A and a multi-functional (meth)acrylate shown by the following formula B are reacted.

Formula A: $(CH_2=CX\text{-}COO)a$ –Y

(in the formula, X denotes hydrogen atom or an alkyl group with 1 to 3 carbons, Y denotes a fluorine-containing alkyl group with 1 to 100 carbon atoms and it may contain one or more ether bonds or ester bonds. "a" is an integer of 1 to 4.).

Formula B: (Q1-O)b-Z-(O-Q2)c

(in the formula, Z denotes an alkyl group with 1 to 100 carbon atoms containing one or more of linear peptide bond, branched peptide bond, cyclic peptide bond, urethane bond, amide bond or imide bond. And, Q1 and Q2 denote (meth)acryloyl group and, "b" and "c" are integers of 1 to 6.).

In the present invention, in order to form the electrically conductive layer and the resin layer, it is possible by preparing a coating liquid of each constituent component preferably dispersed in a solvent, and after coating said coating liquid on a substrate film, by allowing to be dried and cured.

[0032] As solvent preferably used in the present invention, water, lower alcohols, ketones, ethers, cellosolves, esters such as n-butyl acetate, diethylene glycol monomethyl ether acetate, non-polar solvents such as halogenated hydrocarbons, hydrocarbons, fluorine-based solvent, non-protonic polar solvents such as dimethyl imidazolidinone, N-methyl pyrrolidone, dimethyl formamide, diglyme, γ-butyl lactone, propylene glycol monomethyl ether, dimethyl sulfoxide are mentioned. In particular, when the multilayer film of the present invention is produced, in view of dispersibility of metal particles, non-protonic polar solvent is preferable. And, in case where the substrate film is an aromatic polycarbonate film, lower alcohols, cellosolves, esters, their mixture or the like are preferable.

[0033] Concretely, in case where an electrically conductive layer is formed, a coating liquid in which a mixture of inorganic particles and uncured multi-functional

(meth)acryl-based binder is dispersed by using as solvent at least one kind selected from dimethyl imidazolidinone, N-methyl pyrrolidone, dimethyl formamide, diglyme, γ-butyl lactone, propylene glycol monomethyl ether and dimethyl sulfoxide is coated at least one surface of a substrate film and then dried and cured, and an electrically conductive layer can be formed.

[0034] An amount of the solvent used here can be appropriately changed according to the necessary viscosity of the composition, aimed thickness of cured film, drying temperature condition, etc. Usually, based on 1 parts by weight of the total amount of component such as the mixture of the inorganic particles and the uncured multi-functional (meth)acryl-based binder in the coating liquid, it is preferably 0.1 to 30 times parts by weight, more preferably 0.5 to 28 times parts by weight, still more preferably 1 to 20 times parts by weight.

[0035] Furthermore, in case where a resin layer is formed, a coating liquid in which a mixture of the fluorine-containing compound and the multi-functional (meth)acrylate is dispersed by using as solvent at least one kind selected from fluorine-based solvent, dimethyl imidazolidinone, N-methyl pyrrolidone, dimethyl formamide, diglyme, γ-butyl lactone, propylene glycol monomethyl ether and dimethyl sulfoxide is coated and then dried and cured, to thereby form a resin layer.

[0036] The amount of solvent in this case is also appropriately changed according to necessary viscosity of the composition, aimed thickness of cured film, drying temperature condition, etc. Usually, based on 1 part by weight of the total amount of component such as the fluorine-containing compound and the multi-functional (meth)acrylate in the coating liquid, it is preferably 0.05 to 100 times parts by weight, more preferably 0.1 to 50 times parts by weight, still more preferably, 1 to 40 times parts by weight.

[0037] In the present invention, an initiator may be used to accelerate curing of the fluorine-containing compound and the multi-functional (meth)acrylate. As said initiator, those capable of initiating or accelerating polymerization and/or cross-linking of the coating liquid by radical reaction, anionic reaction, cationic reaction or the like are preferable.

[0038] In such a case, as the initiator used for the polymerization reaction and cross-linking reaction, those publicly known or well known can be used. In this case, a plural of photopolymerization initiator or thermal polymerization initiator may be used. As examples of the thermal polymerization initiator, an inorganic peroxide, an azo compound and an organic peroxide are mentioned. And, as examples of the photopolymerization initiator, an aryl ketone-based photopolymerization initiator, a sulfur-containing photopolymerization initiator, an acylphosphine oxide-based photopolymerization initiator, an amine-based photosensitizer or the like are mentioned. Where, the ratio of said initiator in the above-mentioned coating liquid is, based on 100 parts by weight of the total amount of the uncured component such as the fluorine-containing compound and the multi-functional (meth)acrylate in said coating liquid, preferably 0. 01 to 20 parts by weight, and especially 0. 1 to 10parts by weight is preferable.

[0039] The multilayer film of the present invention is, like the multilayer structure schematically shown in Fig. 1 (cross-sectional drawing of multilayer film), a multilayer film in which at least one layer of the electrically conductive layer 2 is provided on at least one surface side of the substrate film, and further, at least one layer of the resin layer 3 is provided on said electrically conductive layer. Although the electrically conductive layer may be provided on both of front and back surfaces of the substrate film, in this case, it is preferable that the resin layer is provided on at least one electrically conductive layer among the both electrically conductive layers. Furthermore, in case where a plural of the electrically conductive layer is provided on one surface side of the substrate film, it is preferable that the plural of the resin layer is provided on the same side of the substrate film such that the outermost surface is the resin layer. Furthermore, a hard coat layer may be provided between the substrate film and the electrically conductive layer. Or, to the substrate film, on surface opposite to the electrically conductive layer, a primary layer or a transparent electrically conductive layer may be provided. Or, on surface of the resin layer, a moisture prevention layer or a protective layer may be provided. It is preferable that

the thicknesses of said moisture prevention layer and said protective layer are 20nm or less, in order not to affect the anti-reflection property.

[0040] In the present invention, as the component constituting the hard coat layer, resins obtainable by polymerization and/or reaction of a compound containing a multi-functional (meth)acrylate which has one or more (meth)acryloyl groups in one molecule are mentioned. As concrete examples of the multi-functional (meth)acrylate, pentaerythritol tri(meth)acrylate, pentaerythritol tetra(meth)acrylate, dipentaerythritol tri(meth)acrylate, dipentaerythritol tetra(meth)acrylate, dipentaerythritol penta(meth)acrylate, dipentaerythritol hexa(meth)acrylate, trimethylol propane tri(meth)acrylate, methyl (meth)acrylate, n-butyl (meth)acrylate, polyester (meth)acrylate, lauryl (meth)acrylate, hydroxyethyl (meth)acrylate, hydroxypropyl (meth)acrylate or the like are mentioned. These can be used alone or as a mixture of two kinds or more.

[0041] The thickness of the hard coat layer can be selected according to its applications, but usually it is 1 μm to 50 μm, preferably 2 μm to 30 μm. If the thickness of the hard coat layer is less than 2 μm, it is likely be scratched because of its insufficiency of surface hardness. And, in case where it exceeds 50 μm, the hardened surface film may become brittle and the hard coat layer is likely to be cracked when the surface hardened film is flexed.

[0042] The multilayer film of the present invention can be preferably applied to image display devices such as liquid crystal display device (LCD), plasma display panel (PDP), electro luminescence display (ELD) or cathode-ray tube display device (CRT). Other than that, it can be applied to a curve mirror, back mirror, goggles, window glass, poster, advertising tower and other various kinds of commercial displays. In case where the multilayer structure of the present invention has a transparent support, the transparent support side is adhered to an image display surface of the image display device.

[0043]

[Examples] Next, the present invention will now be further described in detail with reference to Examples and Comparative examples. Where, in the description, the

"part" and the "%" are on the weight basis unless otherwise specified. Fig. 1 is a schematic cross-sectional view of the multilayer film, and in the multilayer film, an electrically conductive layer 2 and a resin layer 3 are laminated on the substrate film 1.

[0044] [Example 1] A multilayer film having the configuration shown in Fig. 1 was prepared according to the procedure below.

[0045] (Formation of electrically conductive layer 2 containing inorganic particles) Zinc antimonate sol (solid content 30.8%) 225g, pentaerythritol triacrylate 24g, pentaerythritol triacrylate hexamethylene diisocyanate urethane prepolymer 6g and 2-methyl-1-[4-(methyl thio)phenyl]-2-morpholinopropane-1-on 1.8g were dissolved in 75g of dimethyl imidazolidinone. After the mixture was stirred, it was coated on one surface of 188 μm thickness polyester film188U42 (substrate film 1: produced by Toray Industries, Inc.) by using a bar coater, and after drying at 80°C, an ultraviolet light of 480mJ/cm^2 was irradiated to cure the coated layer and to form an electrically conductive layer 2 of 4 μm thickness.

[0046] (Preparation of multilayer film) 2,2,3,3-tetrafluoropropyl methacrylate 0.3g, pentaerythritol triacrylate hexamethylene diisocyanate urethane prepolymer 0.03g and 2-methyl-1-[4-(methyl thio)phenyl]-2-morpholinopropane-1-on 0.02g were dissolved in N-methyl pyrrolidone 7.2g. The coating liquid obtained by stirring the mixture was coated on surface of the electrically conductive layer 2 by using a bar coater, and after drying at 120°C, an ultraviolet light of 480mJ/cm^2 was irradiated to cure the coating layer and to form a resin layer 3 having a thickness of about 0.1 μm and a refractive index of 1.46. For the obtained multilayer film, reflectance at a wavelength of 450 to 650nm, close contactness, and steel wool hardness of surface were measured. The results are shown in Table 1.

[0047] [Example 2] As a multilayer film of the configuration shown in Table 1, a substrate film 1 and an electrically conductive layer 2 were formed in the same way as Example 1. Next, β-(perfluorooctyl) ethyl (meth)acrylate 0.3g, pentaerythritol triacrylate hexamethylene diisocyanate urethane prepolymer 0.03g, 2-methyl-1-[4-(methyl thio)phenyl]-2-morpholinopropane-1-on 0.02g and dimethyl imidazolidinone 5.7g were mixed. The coating liquid obtained by stirring the mixture

was coated on surface of the electrically conductive layer 2 by using a bar coater, and after drying at 120°C, an ultraviolet light of 480mJ/cm^2 was irradiated to cure the coating layer and to form a resin layer 3 having a thickness of about 0.1 μm and refractive index of 1.43. The evaluation results are shown in Table 1.

[0048] [Example 3]

(Preparation of substrate film 1) Pentaerythritol hexaacrylate 51 parts, polyester acrylate 7 parts, hydroxypropyl acrylate 3 parts and an initiator "Irgacure 184" (produced by Ciba Specialty Chemicals) 5 parts were dissolved in a mixed solvent of toluene 27 parts, methyl ethyl ketone 27 parts, isopropyl alcohol 18 parts and butyl acetate 18 parts to prepare a coating liquid for hard coat. This coating liquid for hard coat was coated on one surface of 188 μm thickness polyester film (Lumirror, produced by Toray Industries, Inc.) and was cured to provide a hard coat layer of a thickness of about 5.0 μm. This film provided with the hard coat layer is used as the substrate film.

(Formation of electrically conductive layer 2) A mixture of zinc antimonate sol (solid content 50.8%) 265g, pentaerythritol triacrylate hexamethylene diisocyanate urethane prepolymer 17g, 2-methyl-1-[4-(methyl thio)phenyl]-2-morpholinopropane-1-on 8g dissolved in 220g dimethyl imidazolidinone was stirred and then coated on the hard coat layer of said substrate film by using a bar coater, and after drying at 80°C, an ultraviolet light of 480mJ/cm^2 was irradiated to cure the coating layer and to form an electrically conductive layer 2 of a thickness of 0.087 μm.

(Formation of resin layer 3) 2,2,3,3-tetrafluoropropyl methacrylate 0.3g, pentaerythritol triacrylate hexamethylene diisocyanate urethane prepolymer 0.03g, 2-methyl-1-[4-(methyl thio)phenyl]-2-morpholinopropane-1-on 0.02g were dissolved in N-methyl pyrrolidone 7.2g. The coating liquid obtained by stirring the mixture was coated on surface of said electrically conductive layer 2 by using a bar coater, and after drying at 120°C, an ultraviolet light of 480mJ/cm^2 was irradiated to cure the coating layer and to form a resin layer 3 of a thickness of about 0.1 μm and a refractive index of 1.46. For the obtained multilayer film, reflectance at wavelength of

450 to 650nm, close contactness and steel wool hardness of surface were measured. The evaluation results are shown in Table 1.

[0049] [Comparative example 1] A multilayer structure comprising a substrate film 1 and an electrically conductive layer 2 was formed in the same way as Example 1. The evaluation results are shown in Table 1.

[0050] [Comparative example 2] 2,2,3,3-tetrafluoropropyl methacrylate 0.3g, pentaerythritol triacrylate hexamethylene diisocyanate urethane prepolymer 0.03g and 2-methyl-1-[4-(methyl thio)phenyl]-2-morpholinopropane-1-on 0.02g were dissolved in N-methyl pyrrolidone 7.2g. The coating liquid obtained by stirring the mixture was coated on surface of the substrate film 1 by using a bar coater and after drying at 120°C, it was cured by irradiating an ultraviolet light of 480mJ/cm^2 to cure the coated layer and to form a resin layer 3 of a thickness of about 0.1 μm and a reflectance of 1.46. The evaluation results are shown in Table 1.

[0051] [Comparative example 3] As a multilayer film having the configuration shown in Fig. 1, a substrate film 1 and an electrically conductive layer 2 were formed in the same way as Example 1. Next, 2,2,2-trifluoroethyl methacrylate 0.3g, 2-methyl-1-[4-(methyl thio)phenyl]-2-morpholinopropane-1-on 0.02g and N-methyl pyrrolidone 5.7g were mixed. A coating liquid obtained by stirring the mixture was coated on surface of the electrically conductive layer 2 by using a bar coater, and after drying at 120°C, an ultraviolet light of 480mJ/cm^2 was irradiated to cure the coating layer. A resin layer 3 of a thickness of less than 0.1 μm (reflectance was unmeasurable) was formed. The evaluation results are shown in Table 1.

[0052] [Evaluation of Steel Wool Hardness] #0000 steel wool with a load of 250 gf/cm^2 was shuttled back and forth ten times, and the number of scratches was counted. The hardness was classified into five levels depending on the level of scratches (Level 5: no scratches, Level 4: one to five scratches, Level 3: five to ten scratches, Level 2: ten scratches or more, Level 1: scratches on entire surface).

[0053] [Evaluation of degree of close contact (close contactness)] As an evaluation method of depositing strength between the electrically conductive layer comprising the inorganic particles and the soil release layer, the soil release layer is cut into a grid

state, a silicone-based, epoxy-based or acryl-based adhesion tape is adhered thereto and the tape was peeled off to 180° direction, and the number of squares in which the soil release layers were not peeled off in 100 squares in the grid were counted.

[0054] [Evaluation of Surface Resistivity (Antistatic property)] The surface resistivity was measured by HIRESTA, manufactured by Mitsubishi Yuka.

[0055] [Measurement of Average Reflectance] Measurement was performed with a spectrophotometer, U-3410, manufactured by Hitachi Instruments Inc. The back surfaces of sample films were uniformly scratched with a sheet of #320 to #400 waterproof sandpaper and coated with a black paint to thereby perfectly prevent reflectance from the back surface for the measurement. The incident angle was 6 to 10° and the wavelength range for measurement was 380 to 780 nm.

[0056] In Examples 1, 2 and 3, the results were good in all the evaluation items. On the other hand, in Comparative example 1, since the resin layer is not laminated, the reflectance was high and the antireflection effect was insufficient. In Comparative example 2, since the electrically conductive layer was not laminated, the surface resistivity was high and the antistatic property was insufficient. In Comparative example 3, since an acryl resin was not compounded in the resin layer, the steel wool hardness was entirely poor and its hardness was insufficient.

[0057]

[Table 1]

[Table 1]

Laminate	Steel wool hardness	Close contactness	Surface resistivity Ω/square	Average reflectance (%)
Example 1	4	100	10^{8}	1.7
Example 2	4	100	10^{8}	1.2
Example 3	5	100	10^{8}	0.8
Comp. example 1	4	100	10^{8}	7.0
Comp. example 2	4	100	10^{14}	2.0
Comp. example 3	1	100	10^{8}	1.2

[0058]

[Effect of the Invention] According to the present invention, by providing a resin layer of which refractive index is 1.5 or more comprising a specified fluoropolymer and a

specified multi-functional (meth)acrylate on an electrically conductive layer containing inorganic particles, an antireflection film which is low in reflectance, excellent in soil release property and scratch resistance can be obtained. In addition, this multilayer film is high in antistatic property and excellent in flexural property of multilayer film, and preferable for an antireflection film to be applied to a flat TV surface having a large display surface.

[Brief Explanation of the Drawings]

[Fig. 1] Fig. 1 is a schematic cross-sectional drawing of a multilayer film of the present invention.

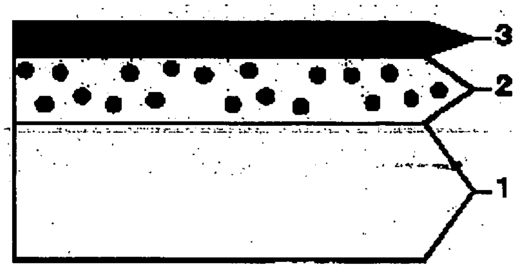
[Explanation of Codes]

1··· substrate film

2··· electrically conductive layer

3··· resin layer

[Fig. 1]



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[F term (reference)]	2H049 BA02 BB67 BC22 2K009 AA04 AA15 BB24 CC02 CC09 CC24 CC26 CC35 DD02 DD05 DD06 EE03 EE05 4F100 AA01B AA01C AA29 AA33 AB18 AK17D AK17E AK17J AK25B AK25C AK25D AK25E AK25J AK41A AL01D AL01E AL05B AL05C AL05D AL05E AL06D AL06E AR00B AR00C AS00B AS00C AT00A BA05 BA07 CA30B CA30C CA30D CA30E DE01B DE01C EG002 EH462 EJ082 EJ542 GB41 JB12D JB12E JG01B JG01C JK12E JK14 JK16 JK17 JM01 JN06 JN18D JN18E